Measurent

Practice Exercises for Section 11.1

- 1. How many feet are in 1 mile? How many ounces are in 1 pound? How many pounds are in 1 ton?
- 2. What is the difference between 1 ounce and 1 fluid ounce?
- 3. What is special about the way units in the metric system are named? eg. Kilometer
- 4. How is 1 milliliter related to 1 gram and to 1 centimeter?
- 7. Which of the following have the same area or mean the same as 3 cm²?
 - · a 3-cm-by 3-cm square

• 3 square centimeters

• 3 cm × 3 cm

- 8. A construction site requires 40 cubic yards of concrete. What does "40 cubic yards of concrete"
- 9. Explain how it could happen that each of two boxes of cereal could be described as larger than the other.

1 mile = 5260 eft

1 oz (mers) (floz (robine) Units in de netri splu lieve perfix of baseund eg, hilo meto

of counte that fits is a lydelydelyd abe. Take 40 such ales.

Large cen mean: - more more.

PROBLEMS FOR SECTION 11.1

- 1. For each of the following metric units, give examples of two objects that you encounter in daily life whose sizes could appropriately be described using that unit.
 - a. meter Height of a building; width of a highway.
 - b. gram Weight of a serving of chips; weight of a amburger patty.
 - c. liter Amount of gas in a car's tank; amount of liquid that a soda container can hold.
 - d. milliliter Amount of contact lens solution needed to store lenses; dosage of cough syrup.
 - e. millimeter Distance between lines on a sheet of notebook paper: length of a pencil.
 - f. kilogram Weight of a chicken from the grocery store;
- g. kilometer Distance from campus to your hometown; distance from New York to Vancouver.

 2. For each of the following items, state which
- U.S. customary units and which metric units in common use would be most appropriate for describing the size of the item. In each case, say briefly why you chose the units.
 - a. The volume of water in a full bathtub
 - b. The length of a swimming pool
 - c. The weight of a slice of bread Ounces; grams
 - d. The volume of a slice of bread
 - e. The weight of a ship Tons; metric tons
 - f. The length of an ant
- Fractions of an inch; millimeters

 3. What does it mean to say that a shape has an area of 8 square inches? Discuss your answer in as clear and direct a fashion as you can.
- 4. Discuss why it is easy to give an incorrect solution to the following area problem and what you must understand about measurement to solve the problem correctly:
 - An area problem: Draw a shape that has an area of 3 square inches.
- 5. Discuss: Why is it not completely correct to describe volume as "length times width times height"? What is a better way to describe what volume means? Give some examples as part of your discussion, using different units of volume.
- 6. Describe how it could happen that three different animals could each be claimed-rightfully-to be the largest of the three. Discuss the implications of this kind of situation for teaching students about measurement.

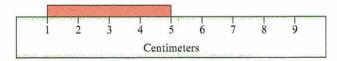
Class Activity 11C Making and Using a Ruler

CCSS SMP3, SMP5, 1.MD.2, 2.MD.1

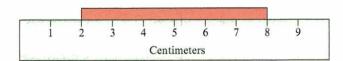
1. Show and discuss how children could make their own inch-ruler using an inch-tile and a cardboard strip like the ones shown below. What do the tick marks and numbers on the ruler mean?



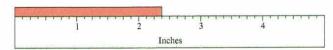
2. Children sometimes try to measure the length of an object by placing one end of the object at the 1 marking instead of the 0 marking, as shown on the centimeter ruler in the figure. Why is the strip below not 5 cm long, even though the end of the strip is at 5? Why might a child put one end of the strip at the 1 marking? Is it possible to measure by starting at 1 or at another tick mark?



3. When asked how long the dark strip in the next figure is, some children will respond that it is 8 cm long. Others will respond that it is 7 cm long. How do you think children come up with these answers?



4. Some students might report that the strip measured by the inch ruler shown is 2.3 inches long. Why is this not correct? What is a correct way to report the length of the strip?



Class Activity 11D ** What Does "6 Square Inches" Mean?

CCSS SMP6, 3.MD.5, 3.MD.6

1. Discuss the following as clearly and concretely as you can, illustrating with 1-inch-by-1-inch tiles if available:

What does it mean to say that a shape has an area of 6 square inches?

Why is it easy to think that a 6-inch-by-6-inch square has area 6 square inches, and why is this not correct?

- 2. Which of the following describe the same area? Why?
 - a. 4 square inches
 - b. A 4-inch-by-4-inch square
 - $c. 4 in^2$
 - d. $4 \text{ in.} \times 4 \text{ in.}$
 - e. A 2-inch-by-2-inch square
 - **f.** 2 in^2

3. People sometimes say, "Area is length times width." Why is it not correct to characterize area this way?

water boils at 212°F

TABLE 11.1 Common units of measurement in the U.S. customary system

Unit	ts in the U.S. Customary Sys	stem
Unit	Abbreviation	Some Relationships between Units
	Units of Length	
inch	in.	
foot	ft	1 ft = 12 in.
yard	yd	1 yd = 3 ft
mile	mi	1 mi = 1760 yd = 5280 ft
	Units of Area	
square inch	in^2	
square foot	ft^2	$1 \text{ ft}^2 = 12^2 \text{ in}^2 = 144 \text{ in}^2$
square yard	yd ²	$1 \text{ yd}^2 = 3^2 \text{ ft}^2 = 9 \text{ ft}^2$
square mile	mi ²	
acre		1 acre = $43,560 \text{ ft}^2$
	Units of Volume	
cubic inch	in ³	
cubic foot	ft ³	$1 \text{ ft}^3 = 12^3 \text{ in}^3 = 1728 \text{ in}^3$
cubic yard	yd ³	$1 \text{ yd}^3 = 3^3 \text{ ft}^3 = 27 \text{ ft}^3$
	Units of Capacity	
teaspoon	tsp	
tablespoon	T or Tbs or Tbsp	1 T = 3 tsp
fluid ounce (or liquid ounce)	fl oz	1 fl oz = 2 T
cup	c	1 c = 8 fl oz
pint	pt	1 pt = 2 c = 16 fl oz
quart	qt	1 qt = 2 pt = 32 fl oz
gallon	gal	1 gal = 4 qt = 128 fl oz
	Units of Weight (Avoirdupoi	is)
ounce	oz	
pound	1b	1 pound = 16 ounces
ton	t	1 ton = 2000 pounds
	Unit of Temperature	
degree Fahrenheit	°F	water freezes at 32°F

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indicates the unit's relationship to the base unit. For example, the prefix *kilo*- means *thousand*, so a *kilometer* is 1000 meters and a *kilogram* is 1000 grams. Many of the metric system prefixes are used only in scientific contexts, not in everyday situations. Some of the metric system prefixes are listed in Table 11.2.

TABLE 11.2 The metric system uses prefixes to create larger and smaller units from base units

Prefix	Meaning	
nano-	$10^{-9} = \frac{1}{1,000,000,000}$	billionth
micro-	$10^{-6} = \frac{1}{1,000,000}$	millionth
milli-	$10^{-3} = \frac{1}{1000}$	thousandth
centi-	$10^{-2} = \frac{1}{100}$	hundredth
deci-	$10^{-1} = \frac{1}{10}$	tenth
deka-	10	ten
hecto-	$10^2 = 100$	hundred
kilo-	$10^3 = 1000$	thousand
mega-	$10^6 = 1,000,000$	million
giga-	$10^9 = 1,000,000,000$	billion

Units in the Metric System			
Unit	Abbreviation	Some Relationships between Units	
	Units of L	ength	
millimeter	mm	$1 \text{ mm} = \frac{1}{1000} \text{ m}$	
centimeter	cm	$1 \text{ cm} = \frac{1}{100} \text{ m} = 10 \text{ mm}$	
meter	m	1 m = 100 cm	
kilometer	km	1 km = 1000 m	
	Units of A	Area	
square millimeter	mm ²		
square centimeter	cm ²	$1 \text{ cm}^2 = 10^2 \text{ mm}^2 = 100 \text{ mm}^2$	
square meter	m ²	$1 \text{ m}^2 = 100^2 \text{ cm}^2 = 10,000 \text{ cm}^2$	
square kilometer	km ²	$1 \text{ km}^2 = 1000^2 \text{ m}^2 = 1,000,000 \text{ m}^2$	
	Units of Vo	olume	
cubic millimeter	mm ³		
cubic centimeter	cm ³ or cc	$1 \text{ cm}^3 = 10^3 \text{ mm}^3 = 1000 \text{ mm}^3$	
cubic meter	m ³	$1 \text{ m}^3 = 100^3 \text{ cm}^3 = 1,000,000 \text{ cm}^3$	
cubic kilometer	km ³	$1 \text{ km}^3 = 1000^3 \text{ m}^3 = 1,000,000,000 \text{ m}^3$	
	Units of Ca	pacity	
milliliter	mL or ml	$1 \text{ mL} = \frac{1}{1000} \text{ L}$	
liter	Lorl	1 L = 1000 mL	
	Units of Mass	(Weight)	
milligram	mg	$1 \text{ mg} = \frac{1}{1000} \text{ g}$	
gram	g		
kilogram	kg	1 kg = 1000 g	
	Unit of Temp	perature	
degree Celsius	°C	water freezes at 0°C water boils at 100°C	

What's spiral about Metri sp:

1 cm high

TABLE 11.4 Relationships among units of capacity, mass, and length in the metric system

1 cu.cm.

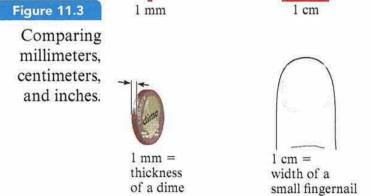
nol.	Relationships of Liter, Gram, and Meter	
1 milliliter of water		
1 milliliter of water	at 4°C) has volume 1 cm ³ so fills a cube that is 1 cm wide, 1 cm long, and	d

	A	Metric	System		
		Prefix	Length	Capacity	Weight
0.001	$\frac{1}{1000}$	milli-	millimeter	milliliter	milligram
0.01	$\frac{1}{100}$	centi-	centimeter		centigram
0.1	1/10	deci-			
1.	2.19.1115.	base unit	meter	liter	gram
10		deka-			
100		hecto-			
1000		kilo-	kilometer		kilogram
		Fundamental	Relationships		
		1 milliliter of water has a volume of 1	— · · · · · · · · · · · · · · · · · · ·		

TABLE 11.5 Summary of the metric system

How Are the Metric and U.S. Customary Systems Related?

Figure 11.3 shows lines of length 1 millimeter, 1 centimeter, and 1 inch. The inch and the centimeter are related by 1 inch = 2.54 centimeters. A meter is about 1 yard and 3 inches. A kilometer is about 0.6 miles, so a bit more than half a mile.





1 inch = 2.54 cmis a little longer than a quarter

ուսույլուսույլուսույլուսույլուսույլուսոլոնուպուսոլուսույլուսո 5 6 9 Centimeter ruler small marks indicate millimeters.

Table 11.6 shows some basic relationships between the U.S. customary and metric systems of measurement.

TABLE 11.6 Relationships between U.S. customary and metric systems

U.S. Customary and Metric		
Length	1 in. = 2.54 cm (exact)	
Capacity	1 gal = 3.79 L (good approximation)	
Weight (mass)	1 kg = 2.2 lb (good approximation)	